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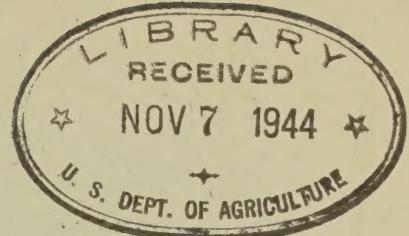
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## AGRICULTURAL NOTES

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### THE SEARCH IN THE AMERICAN TROPICS FOR BENEFICIAL INSECTS FOR INTRODUCTION INTO PUERTO RICO

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#### INTRODUCTION

DURING THE NINE-MONTH PERIOD FROM AUGUST 12, 1935, TO MAY 21, 1936, AN EXTENSIVE SEARCH WAS CONDUCTED IN THE BRITISH WEST INDIES AND IN CERTAIN SOUTH AMERICAN COUNTRIES FOR BENEFICIAL INSECTS SUITABLE FOR INTRODUCTION INTO PUERTO RICO. THE PESTS OF AGRICULTURE FOR WHICH ENEMIES WERE IMPORTED FROM THESE COUNTRIES INCLUDED THE SUGARCANE BORER, DIATRAEA SACCHARALIS, THE COCONUT SCALE, ASPIDIOTUS DESTRUCTOR, THE RED-BANDED THRIPS, HELIOTHrips RUBROCINCTUS, AND THE ONION THRIPS, THRIPS TABACI.

#### PARASITES OF THE SUGARCANE BORER

DIATRAEA SACCHARALIS IS A COSMOPOLITAN SPECIES.

THE SUGARCANE BORER FOUND IN PUERTO RICO MAY WELL BE CONSIDERED A COSMOPOLITAN SPECIES, FOR IT IS INDIGENOUS TO THE CANE-GROWING REGIONS FROM THE SOUTHERN PART OF THE UNITED STATES THROUGH CENTRAL AMERICA AND ALL THE CARIBBEAN ISLANDS AND EXTENDS INTO



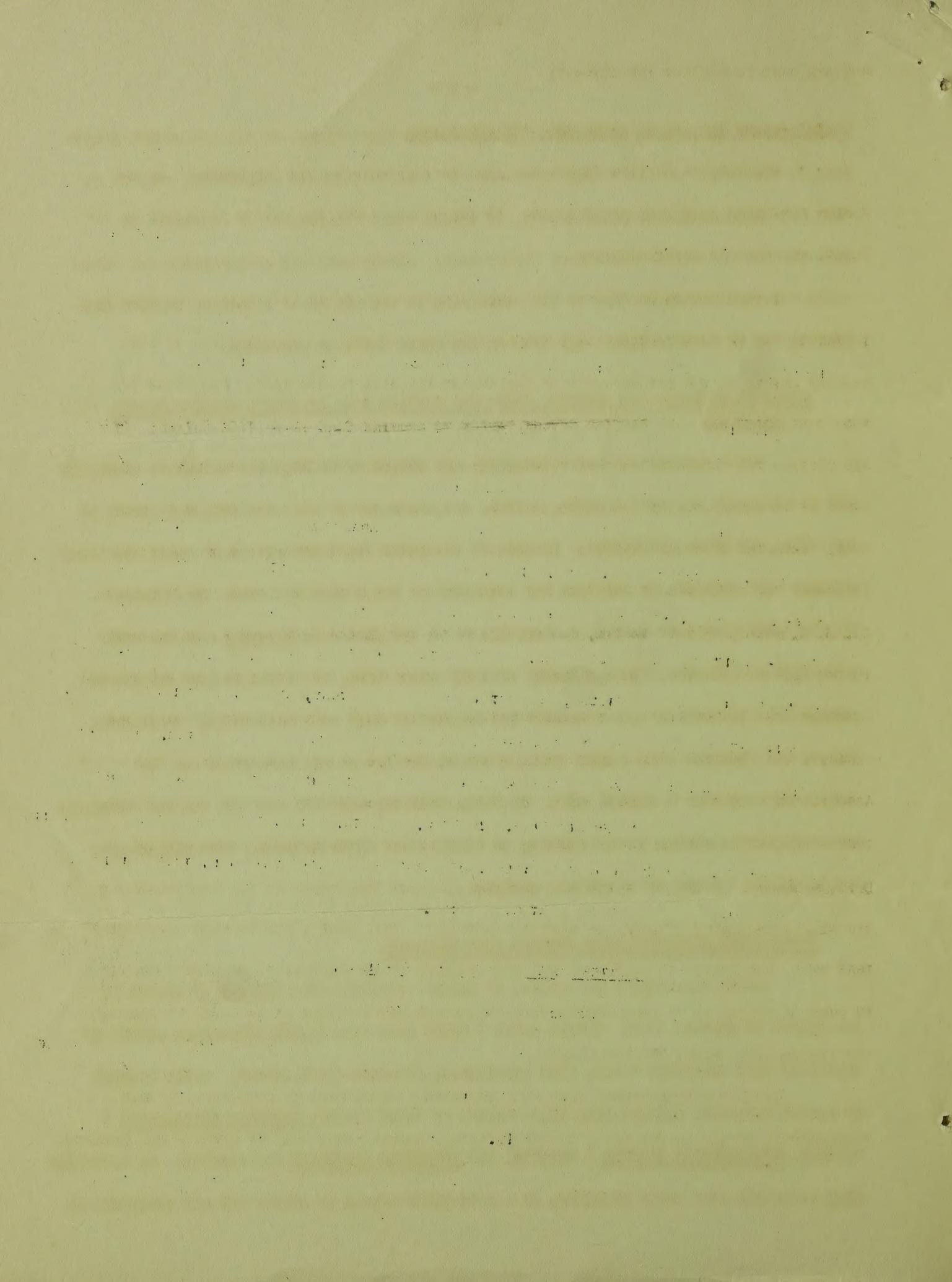
SOUTH AMERICA TO INCLUDE ARGENTINA. IN DEVELOPING THIS PROJECT IT WAS CONSIDERED ADVISABLE TO INTRODUCE PARASITES FROM LOCALITIES OF DIVERSE CLIMATIC CONDITIONS, INSOFAR AS TIME AND FUNDS AVAILABLE WOULD PERMIT, TO ASSURE THE ESTABLISHMENT OF PARASITES IN BOTH THE DRY AND MOIST SECTIONS OF PUERTO RICO. ACCORDINGLY THE EXPLORATIONS FOR PARASITES FOR THIS NOTORIOUS PEST OF CANE WERE MADE IN THE ISLAND OF TRINIDAD, BRITISH WEST INDIES, AND IN BRITISH GUIANA AND PERU ON THE SOUTH AMERICAN CONTINENT.

PARASITE MATERIAL ON SUGARCAKE BORER WAS SHIPPED FROM TRINIDAD, BRITISH GUIANA AND PERU.

AMONG THE FACTORS WHICH INFLUENCE THE CHOICE OF METHODS FOR OBTAINING PARASITES MAY BE MENTIONED THE LIFE HISTORY, HABITS, AND ABUNDANCE OF THE PARASITE, THE SEASON OF THE YEAR, AND LOCAL CONDITIONS. IN EACH OF THE THREE COUNTRIES MENTIONED ABOVE DIFFERENT METHODS WERE UTILIZED IN SECURING THE PARASITES OF THE SUGARCAKE BORER. IN TRINIDAD "DEAD-HEART" SHOOTS OF SUGARCAKE, EXPECTED TO BE INFESTED WITH DIATRAEA BORERS, WERE COLLECTED IN THE CANE FIELDS, BROUGHT INTO THE LABORATORY, AND RETAINED LONG ENOUGH TO PERMIT THE EMERGENCE OF ANY PARASITES THE BORERS MAY HAVE BEEN SUPPORTING. IN BRITISH GUIANA THE PARASITES WERE REARED THROUGH ONE GENERATION IN THE LABORATORY AND THE ADULTS THEN SHIPPED TO PUERTO RICO. IN PERU, HOWEVER, BOTH THE WASP AND THE FLY PARASITES WERE COLLECTED DIRECTLY IN THE FIELDS, OR REARED FROM FIELD MATERIAL, THUS ELIMINATING THE LABORIOUS ROUTINE OF LABORATORY REARING.

THREE BORER PARASITES WERE SHIPPED FROM TRINIDAD.

ACTUAL COLLECTING AND REARING OF BORERS CONTINUED FROM THE END OF AUGUST TO THE MIDDLE OF OCTOBER 1935. DURING THESE 7 WEEKS MORE THAN 17,000 DEAD-HEART SHOOTS OF SUGARCAKE WERE COLLECTED WHICH, UPON DISSECTION, PRODUCED 4,653 BORERS. THREE SPECIES OF LARVAL PARASITES EMERGED FROM 10.5 PERCENT OF THESE BORERS, TERESIA CLARIPALPIS 9 PERCENT, STOMATODEXIA DIADEMA 1 PERCENT, AND APANTELES DIATRAEAE 0.5 PERCENT. NO PARASITES WERE FORWARDED FROM THESE REARINGS, AS A SUFFICIENT NUMBER OF ADULTS WAS NOT AVAILABLE AT



ANY ONE TIME TO WARRANT THE ATTEMPT.

THE AMAZON FLY WAS OBTAINED FROM BRITISH GUIANA.

THE WORK IN BRITISH GUIANA HAD TWO DISTINCT PHASES: (1) THE BREEDING OF THE AMAZON FLY, METAGONISTYLOM MINENSE, AND (2) THE REARINGS FOR THE NATIVE PARASITES OF THE SUGARCAKE BORER IN BRITISH GUIANA.

INTERNATIONAL COOPERATION IN BIOLOGICAL CONTROL OF INSECT PESTS OFTEN RESULTS IN THE SAVING OF MUCH VALUABLE TIME AND CONSIDERABLE MONEY. AN ILLUSTRATION OF SUCH SAVINGS EXISTS IN THE INTRODUCTION OF THE AMAZON FLY INTO PUERTO RICO. FOR YEARS THE SUGARCAKE BORER HAD BEEN CAUSING SEVERE DAMAGE TO GROWING CANE IN BRITISH GUIANA. IT WAS COSTING THE PRODUCERS IN THAT COUNTRY BETWEEN \$30,000 AND \$35,000 ANNUALLY TO HAVE GANGS OF LABORERS COLLECT THE DEAD-HEARTS OF SUGARCAKE TO MITIGATE THE LOSSES BY THAT PEST. WHEN THE IMPERIAL BUREAU OF ENTOMOLOGY SUGGESTED THE INTRODUCTION OF PARASITES TO COMBAT THE BORER MENACE THE IDEA MET WITH INSTANT FAVOR WITH THE PRODUCERS. IN 1928 DR. J. G. MYERS, OF THAT BUREAU, WAS DELEGATED FOR THE EXPLORATORY WORK TO BE CONDUCTED IN THE AMERICAN TROPICS. IN THE SUMMER OF 1932 MYERS FOUND THE AMAZON FLY IN THE JUNGLES BORDERING THE AMAZON RIVER, BUT TRANSPORTATION DIFFICULTIES PREVENTED HIS BRINGING THE PARASITE INTO BRITISH GUIANA THAT YEAR. HOWEVER, THE FOLLOWING YEAR THE SUGAR PRODUCERS' ASSOCIATION PURCHASED A LAUNCH, HIRED AN EXPERIENCED NAVIGATOR TO OPERATE IT, AND MYERS THEN SUCCEEDED IN BRINGING 200 ADULTS OF THE FLY TO THE ENTOMOLOGICAL LABORATORY IN BRITISH GUIANA. THESE 200 FLIES HAD COST THE COMBINED TREASURIES OF THE GOVERNMENT AND THE ASSOCIATION SOME \$35,000, OR \$175 FOR EACH FLY! YET, WHAT A REMUNERATIVE INVESTMENT THAT WAS! THE DAMAGE TO SUGARCAKE HAS BEEN REDUCED BY THE ACTIVITIES OF THIS PARASITE TO SUCH AN EXTENT AS TO MAKE UNNECESSARY THE EMPLOYMENT OF GANGS OF LABORERS TO COLLECT THE DEAD-HEARTS, WHICH ARE NOW SCARCE.

THE TWO ORGANIZATIONS MENTIONED GENEROUSLY COOPERATED BY CONSENTING TO THE INTRODUCTION OF THE AMAZON FLY INTO PUERTO RICO. DURING THE MONTHS OF OCTOBER AND NOVEMBER



7,000 ADULTS OF THESE FLIES WERE BRED IN THE LABORATORY, OF WHICH 6,575 WERE SHIPPED TO PUERTO RICO BY AIR EXPRESS, AND 5,823 WERE ALIVE UPON REACHING THEIR DESTINATION.

ALTHOUGH THE REARINGS FOR THE PARASITES OF THE SUGARCANE BORER NATIVE TO BRITISH GUIANA DID NOT PRODUCE THE DESIRED RESULTS, STILL THE EFFORT IN THAT COUNTRY ENRICHED PUERTO RICO BY THE ADDITION OF TWO NEW BENEFICIAL INSECTS, ALL POTENTIAL ENEMIES OF THE SUGARCANE BORER, VIZ., THE AMAZON FLY, AND A DEXIID FLY, STOMATODEXIA DIADEMA. A THIRD SPECIES, BASSUS STIGMATERUS, WAS INCLUDED IN THESE SHIPMENTS, BUT IT HAD ALREADY BEEN ESTABLISHED IN PUERTO RICO FROM IMPORTATIONS MADE BY H. E. BOX FROM BRITISH GUIANA IN 1924-25.

TWO SPECIES OF BORER PARASITES WERE OBTAINED FROM PERU.

THE ACTIVITIES IN PERU WERE CONDUCTED AT A MOST OPPORTUNE TIME INsofar AS SEASONAL ABUNDANCE OF THE PARASITES IS CONCERNED. IN ADDITION WE WERE FAVORED WITH A MORE FREQUENT AIRPLANE SERVICE TO PUERTO RICO THAN WAS THE CASE IN THE OTHER COUNTRIES IN WHICH WE WORKED. WE WERE THUS ENABLED TO ORGANIZE THE PROJECT AND TO COLLECT AND SHIP NEARLY 11,000 WASPS AND 1,700 FLIES TO PUERTO RICO DURING THE PERIOD FROM APRIL 7 TO MAY 21, 1936. INCIDENTALLY, IT MAY BE MENTIONED THAT BECAUSE OF THE LARGE NUMBER SENT TO THE CANE FIELDS OF PUERTO RICO, CERTAINLY ADEQUATE TO INSURE THEIR ESTABLISHMENT IF CONDITIONS WERE SUITABLE, ONE CONSIGNMENT OF THE TWO SPECIES, CONTAINING NEARLY 3,000 IPOBRACON RIMAC AND 300 TERESIA CLARIPALPIS, WAS SHIPPED TO FLORIDA. WE WERE ABLE TO COLLECT LARGE NUMBERS OF THESE TWO PARASITES BECAUSE THE SUGARCANE BORER INFESTS CORNSTALKS IN PERU AS WELL AS CANE STALKS; AND IT IS MUCH EASIER TO DISSECT THE FORMER TO GET PARASITE MATERIAL THAN IT IS TO DISSECT CANE STALKS. CORNFIELDS IN PERU ARE TO BE FOUND IN ABUNDANCE NEAR ALL CANE-GROWING REGIONS DESPITE OBSERVATIONS TO THE CONTRARY RECORDED IN ENTOMOLOGICAL LITERATURE IN 1932.

SHOULD THESE TWO PARASITES FROM PERU BECOME ESTABLISHED IN THE DRY SECTIONS OF PUERTO RICO ALONG ITS SOUTHERN COAST, AND SHOULD THE AMAZON FLY TAKE HOLD IN THE MORE

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WET AREAS OF THE EAST COAST AND THE NORTH, IT IS HOPED THAT A REDUCTION IN BORER INJURY WILL RESULT.

#### THE THrips PARASITE

##### TRINIDAD GOVERNMENT MADE AVAILABLE THrips PARASITES.

SHORTLY AFTER THE ARRIVAL OF THE WRITER IN TRINIDAD, B.W.I., IN AUGUST 1935, THE DEPARTMENT OF AGRICULTURE OF TRINIDAD AND TOBAGO RECEIVED THE FIRST CONSIGNMENT OF THE CACAO THrips PARASITE, DASYSCAPUS PARVIPENNIS GAHAN, FROM THE GOLD COAST, AFRICA. DURING SOME YEARS IN THE GOLD COAST THIS TINY WASP HAS BEEN REPORTED TO REDUCE THE CACAO THrips TO THE EXTENT OF 80 PERCENT OR MORE. SINCE FOR MANY YEARS THE SAME SPECIES OF THrips HAD BEEN A VERY SERIOUS PEST OF CACAO IN TRINIDAD, THIS FIRST ATTEMPT AT ITS BIOLOGICAL CONTROL WAS BEING MADE WITH A PARASITE OF PROVED VALUE. DASYSCAPUS WAS RECOVERED SOON AFTER THE INITIAL LIBERATIONS WERE MADE IN CACAO PLANTATIONS IN CENTRAL TRINIDAD, WHEREUPON OUR REQUEST FOR BREEDING STOCK WAS GENEROUSLY GRANTED BY THE GOVERNMENT OFFICIALS OF THE ISLAND. THIRTY-EIGHT MALE AND 61 FEMALE ADULTS WERE PRESENTED TO US ON FEBRUARY 15, 1936, AND THESE WERE IMMEDIATELY USED IN BREEDING OTHERS. SIXTEEN DAYS LATER, ON MARCH 2, 1,556 PUPAE OF DASYSCAPUS WERE ON THEIR WAY TO PUERTO RICO. IT MAY BE OF INTEREST TO NOTE HERE THAT THIS PARASITE WAS SHIPPED IN THE PUPAL STAGE WHEREAS ALL OTHER SPECIES SENT TO PUERTO RICO BY THE WRITER, 14 IN ALL, WERE SHIPPED AS ADULTS. THIS WAS DEEMED NECESSARY BECAUSE UNDER LABORATORY CONDITIONS THE ADULT DASYSCAPUS IS VERY SHORT-LIVED, SURVIVING ONLY 4 OR 5 DAYS, WHEREAS THE INTERVAL BETWEEN DEPARTURES OF AIRPLANES FOR PUERTO RICO WAS 7 DAYS. SINCE ALL THE MATERIAL WAS LABORATORY BRED IT WAS ABSOLUTELY FREE FROM HYPERPARASITES; MOREOVER, THE LONG PUPAL PERIOD OF THE PARASITE, 11 DAYS, MADE POSSIBLE THE ACCUMULATION OF MAXIMUM NUMBERS FOR THE SINGLE SHIPMENT OUR SCHEDULE OF OPERATIONS WOULD PERMIT.

DR. K. A. BARTLETT, OF THE STAFF OF THE PUERTO RICO EXPERIMENT STATION, UNITED STATES DEPARTMENT OF AGRICULTURE, AT MAYAQUEZ, WHO RECEIVED THE SHIPMENT FROM TRINIDAD,



CARED FOR THE EMERGING ADULTS, MADE THE FIELD LIBERATIONS, AND INFORMED THE WRITER UPON HIS RETURN TO PUERTO RICO LATE IN MAY 1936 THAT HE HAD VERY RECENTLY MADE THE FIRST RECOVERIES OF THE SPECIES AT THE FOCUS OF THE ORIGINAL LIBERATION ON THE WESTERN END OF THE ISLAND. THE DEFINITE ESTABLISHMENT OF THIS MINUTE PARASITE WAS INDEED MOST GRATIFYING, AND A MOST APPROPRIATE "WELCOME BACK!" TO THE WRITER.

#### ENEMIES OF THE COCONUT SCALE

##### EFFECTIVE PREDATORS EXIST IN TRINIDAD.

DURING RECENT YEARS THE EXTENSIVE COCONUT GROVES ALONG THE EASTERN SHORES OF PUERTO RICO, AS WELL AS THOSE OCCURRING GENERALLY OVER THE ISLAND, ARE SAID TO HAVE BEEN PERIODICALLY AND AT TIMES RATHER SEVERELY INJURED LOCALLY BY THE RAVAGES OF THE COCONUT SCALE, ASPIDIOTUS DESTRUCTOR. TO REDUCE FUTURE DAMAGE TO THE COCONUT PALM THROUGH THAT SOURCE SEVERAL SPECIES OF LADYBIRD BEETLES WERE INTRODUCED FROM TRINIDAD. THERE THESE SAME SPECIES OF LADYBIRDS KEEP THAT AND OTHER RELATED SOFT-SCALE INSECTS IN CONTROL AT ALL TIMES.

THE ADULT BEETLES WERE COLLECTED DAILY IN THE COCONUT GROVES AND CARED FOR IN THE LABORATORY UNTIL SUFFICIENT NUMBERS HAD ACCUMULATED FOR ONE OR MORE COLONIES. THE BEETLES WERE NOT ABUNDANT WHERE THE COLLECTIONS WERE BEING MADE, AT TIMES FEWER THAN TEN INDIVIDUALS CONSTITUTING ONE FULL DAY'S EFFORTS. ON THE DAYS WHEN PLANES WERE SCHEDULED TO LEAVE TRINIDAD FOR PUERTO RICO THE BEETLES WERE EXAMINED INDIVIDUALLY AND CLASSIFIED, THE NUMBERS OF EACH SPECIES WERE RECORDED, AND THEN THEY WERE PLACED IN SHIPPING CONTAINERS PROVIDED WITH AMPLE FOOD FOR THE TWO-DAY JOURNEY.

##### NUMBERS AND SPECIES SHIPPED.

TWO CONSIGNMENTS WERE SHIPPED TO PUERTO RICO, BOTH ARRIVING THERE IN EXCELLENT CONDITION WITH A TOTAL MORTALITY OF ABOUT 7 PERCENT FOR THE 431 INDIVIDUALS SENT. THE NUMBERS OF THE DIFFERENT SPECIES SENT ARE: 273 CYPTOGNATHA NODICEPS, 47 CYPTOGNATHA

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SIMILLIMA, 68 PENTILIA CASTANEA, 11 AZYA TRINITATIS, 17 SCYMNUS AENEIPENNIS, AND 15 ADULTS OF MISCELLANEOUS BENEFICIAL SPECIES, AMONG WHICH ARE REPRESENTED TWO SPECIES OF HYPERASPIS. FOUR HUNDRED OF THE 431 ADULTS REACHED PUERTO RICO ALIVE.

SUMMARY

THE WRITER SAILED FROM PONCE ON AUGUST 10, 1935, AND RETURNED TO SAN JUAN ON MAY 29, 1936. DURING THIS PERIOD HE CARRIED ON HIS INVESTIGATIONS FOR BENEFICIAL INSECTS FOR INTRODUCTION INTO PUERTO RICO IN THREE ISLANDS OF THE WEST INDIES AND IN TWO COUNTRIES OF SOUTH AMERICA. THE BENEFICIAL INSECTS SENT TO PUERTO RICO TOTALED 21,050 INDIVIDUALS SENT IN 20 AIR-EXPRESS CONSIGNMENTS. THIS TOTAL INCLUDED 8,296 DIPTERA, 12,323 HYMENOPTERA, AND 431 COLEOPTERA. AT LEAST 12 SPECIES NEW TO THE INSECT FAUNA OF PUERTO RICO WERE INTRODUCED AS THE RESULT OF THE EXPLORATORY WORK, ALL OF WHICH ARE OF A BENEFICIAL NATURE. IN TABLE I, WHICH FOLLOWS, ARE LISTED THE NUMBERS OF THE DIFFERENT SPECIES SENT AND THE NUMBERS RECEIVED ALIVE IN PUERTO RICO.

TABLE I.— A LIST OF THE SPECIES OF BENEFICIAL INSECTS INTRODUCED INTO PUERTO RICO DURING THE ENTOMOLOGICAL EXPLORATIONS OF 1935-36 BY S. M. DOHANIAN; THE NUMBERS OF INDIVIDUALS OF EACH SPECIES SHIPPED AND RECEIVED ARE ALSO SHOWN

| SPECIES  | NUMBERS SHIPPED | NUMBERS RECEIVED ALIVE |
|--|-----------------|------------------------|
| FOR THE CONTROL OF THE SUGARCAKE MOTH BORER:           |                 |                        |
| <u>METAGONISTYLOM MINENSE</u>                          | 6,575           | 5,823                  |
| <u>STOMATODEXIA DIADEMA</u>                            | 8               | 8                      |
| <u>TERESIA CLARIPALPIS</u>                             | 1,713           | 557                    |
| <u>BASSUS STIGMATERUS</u>                              | 62              | 61                     |
| <u>IPOBRACON RIMAC</u>                                 | 10,705          | 7,912                  |
| TOTALS   | 19,063          | 14,361                 |
| FOR THE CONTROL OF THE CACAO AND OTHER THIRIPS:        |                 |                        |
| <u>DASYSCAPUS PARVIPENNIS</u>                          | 1,556           | 1,167                  |
| FOR THE CONTROL OF THE COCONUT SCALE AND OTHER SCALES: |                 |                        |
| <u>AZYA TRINITATIS</u>                                 | 11              |                        |
| <u>CRYPTOGNATHA NODICEPS</u>                           | 273             |                        |
| <u>CRYPTOGNATHA SIMILLIMA</u>                          | 47              |                        |
| <u>PENTILIA CASTANEA</u>                               | 68              |                        |
| <u>SCYMNUS AENEIPENNIS</u>                             | 17              |                        |
| MISCELLANEOUS BENEFICIAL BEETLES                       | 15              |                        |
| TOTALS   | 431             | 400                    |
| TOTAL OF ALL SPECIES:                                  | 21,050          | 15,928                 |

